Course's Name :analog communication
Course's Number :
Exam's Period 1hours
Questions' Number :4
Total Mark :30
Pages' Number4:

14/30

Palestine Technical University - Kadoorie

first……Exam
first……Semester 2012/2013

Instructor's Name :
Student's Name: [redacted]
Student's Number: [redacted]
Section's Number: ……………………………
Exam's Date : ~~11/04/2013~~ 9/5/2013
Form :

Q1)Given the following LTI system.

3/8

Find y(t) for the following two cases

$$X(t) \longrightarrow \boxed{h(t)} \longrightarrow y(t)$$

AT sinc fT   2AT Sin 2ft

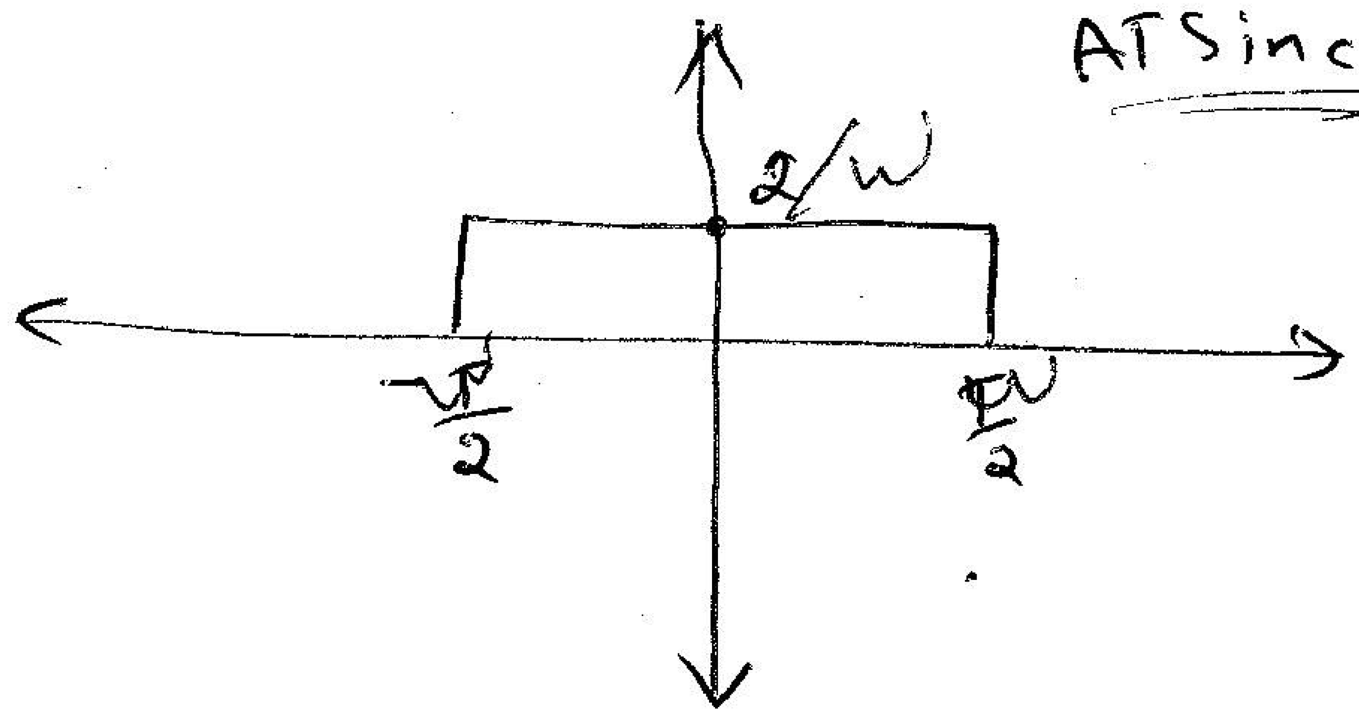
a)(4 marks) $x(t) = 2\sin c(Wt)$ $h(t) = 4\sin c(2Wt)$

b)(4 marks) $x(t) = \cos(2\pi 1000t) + \sin(6\pi 1000t)$
2LT f +
$h(t) = 4\sin c(2000t)$

— ATSinc fT
— 2ATSinc2fT
— AT Sin 2fT

a) ~~x(f)~~ $y(t) = x(t)\, h(t)$

$x(t) =$

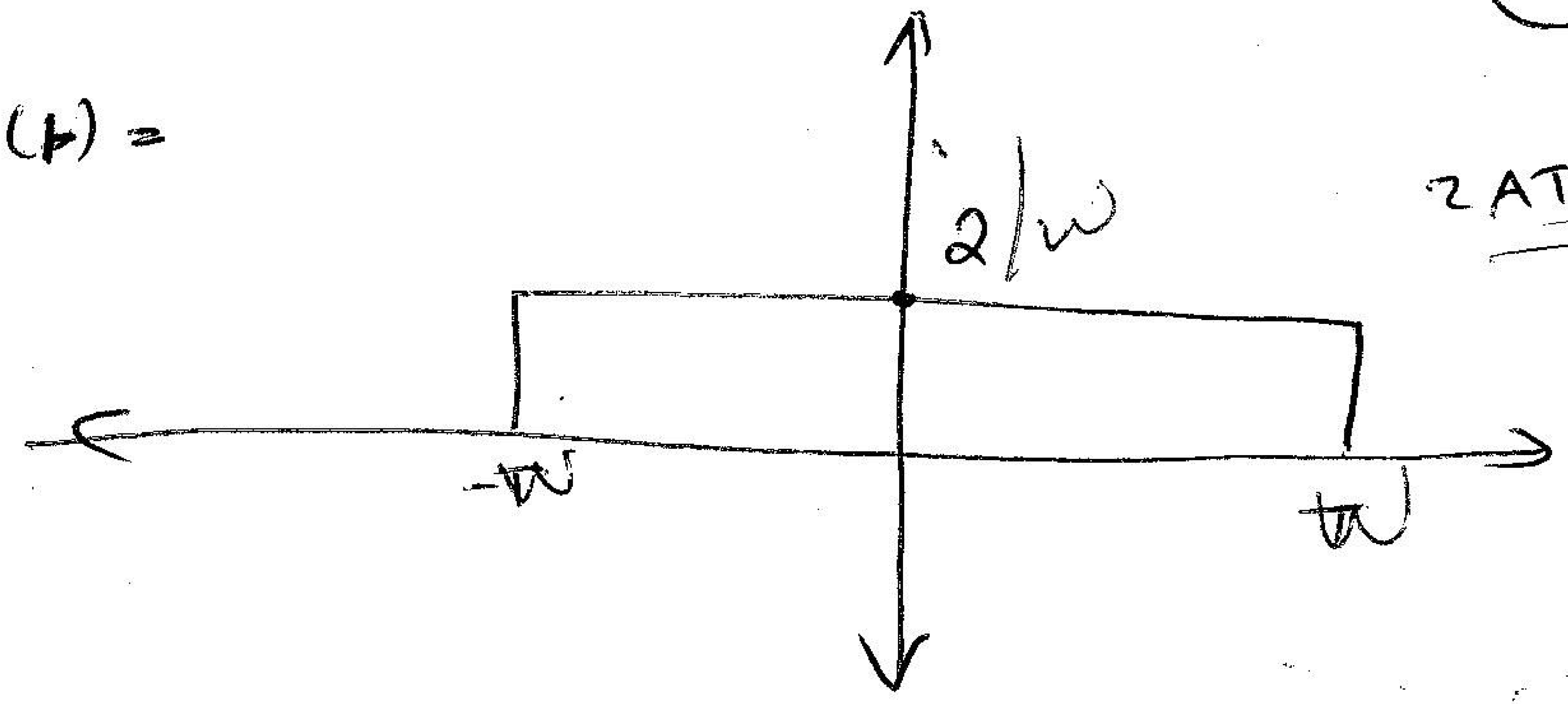


ATSinc fT

2

العلامات تحاليلية
لحفص لهرياد
الامتحان الأول

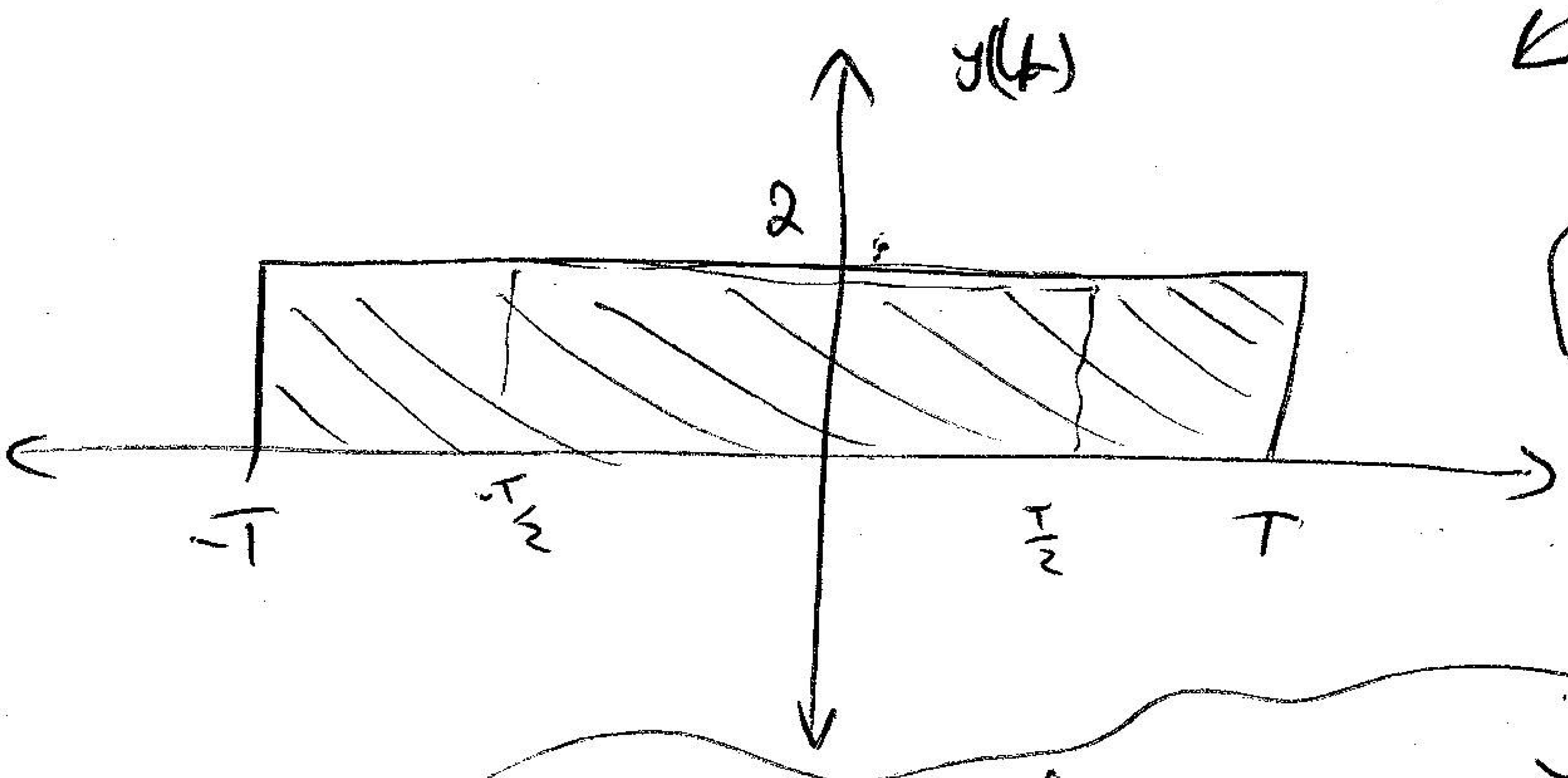
$h(t) =$



2ATSinc2fT

~~X(f)~~

x(t) h(t)



$\therefore y(t) = h(t) = 4\sin c(2wt)$

تم الرفع بواسطة م. معن أبو حسين

(b) $\cos(2\pi 1000t) + \sin(6\pi 1000t) \Rightarrow \underline{x(t)}$

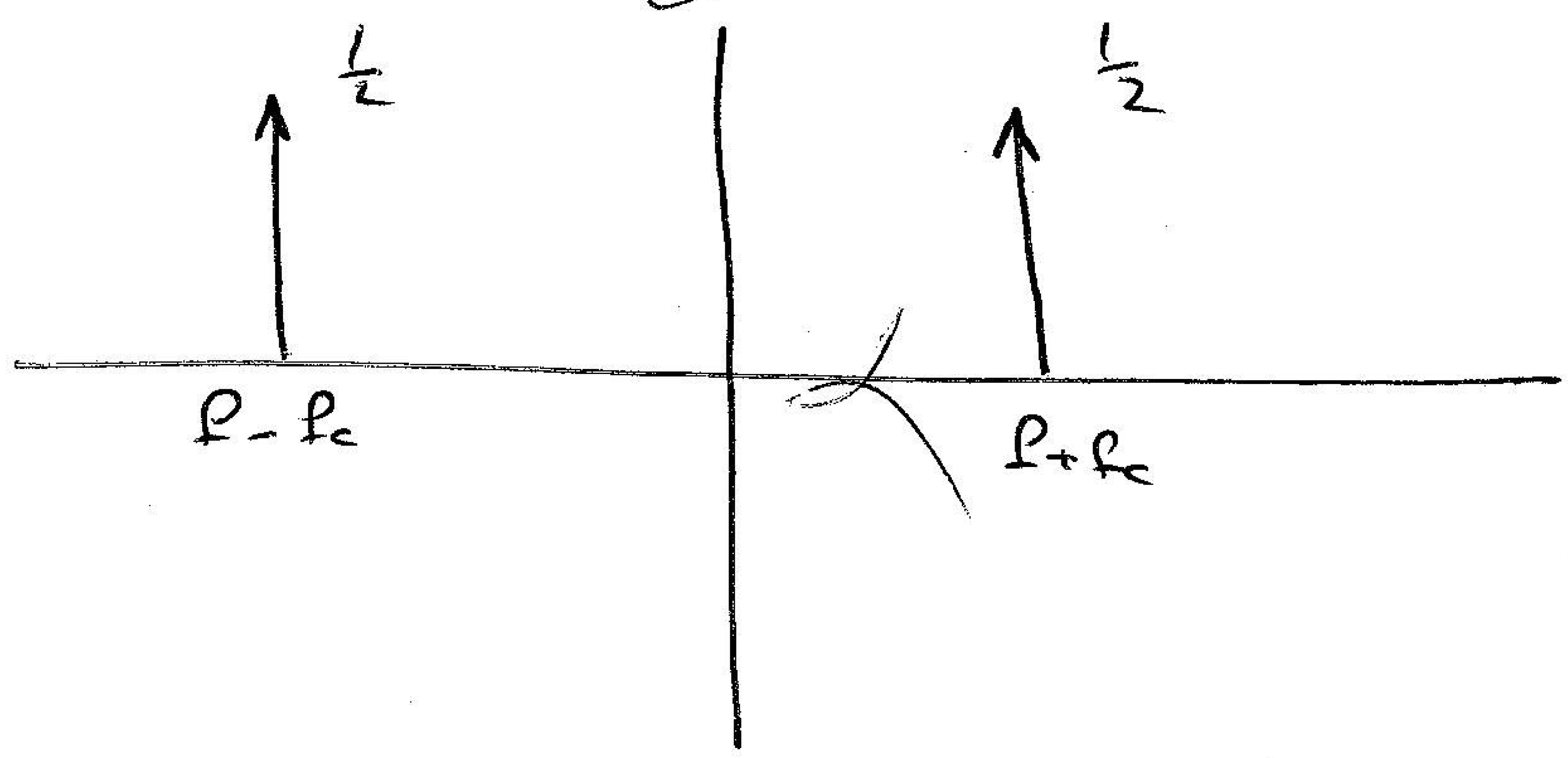
$4\,\mathrm{sinc}(2000t) \Rightarrow \underline{h(t)} \Rightarrow 4\,\mathrm{sinc}\, ft$

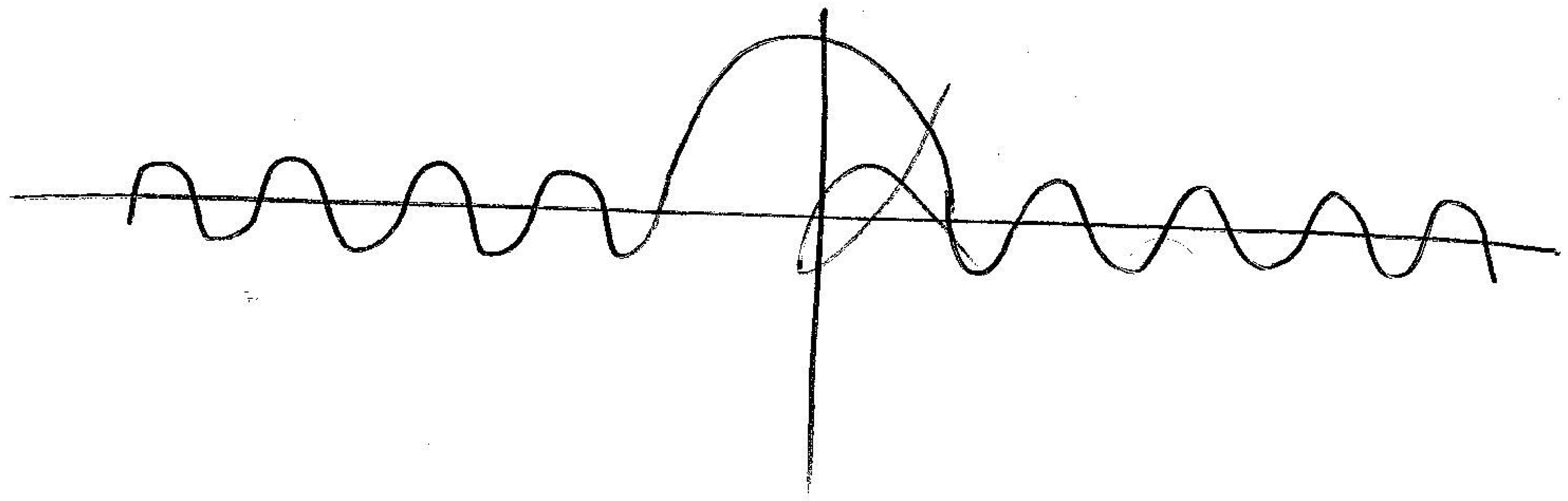
$\cos(2\pi ft) + \sin 2\pi ft$

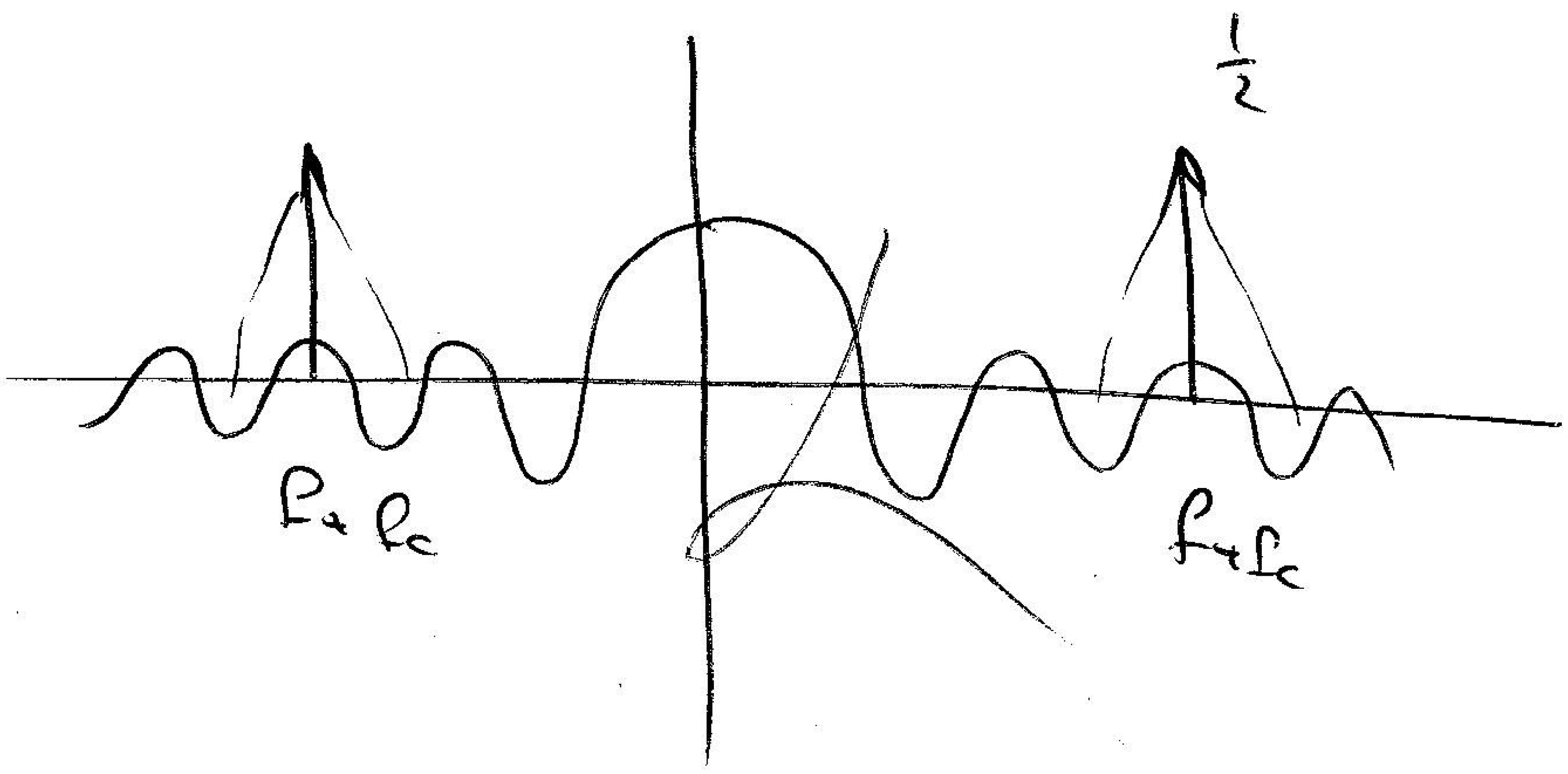
$F(\cos 2\pi ft) = \frac{1}{2}\delta(f-f_c) + \frac{1}{2}\delta(f+f_c)$

1

$F(\sin 2\pi ft) = \frac{1}{2j}\delta(f-f_c) + \frac{1}{2j}\delta(f+f_c)$







Course's Name : *analog communication*
Course's Number :
Exam's Period *1hours*
Questions' Number :4
Total Mark :*30*
Pages' Number4:

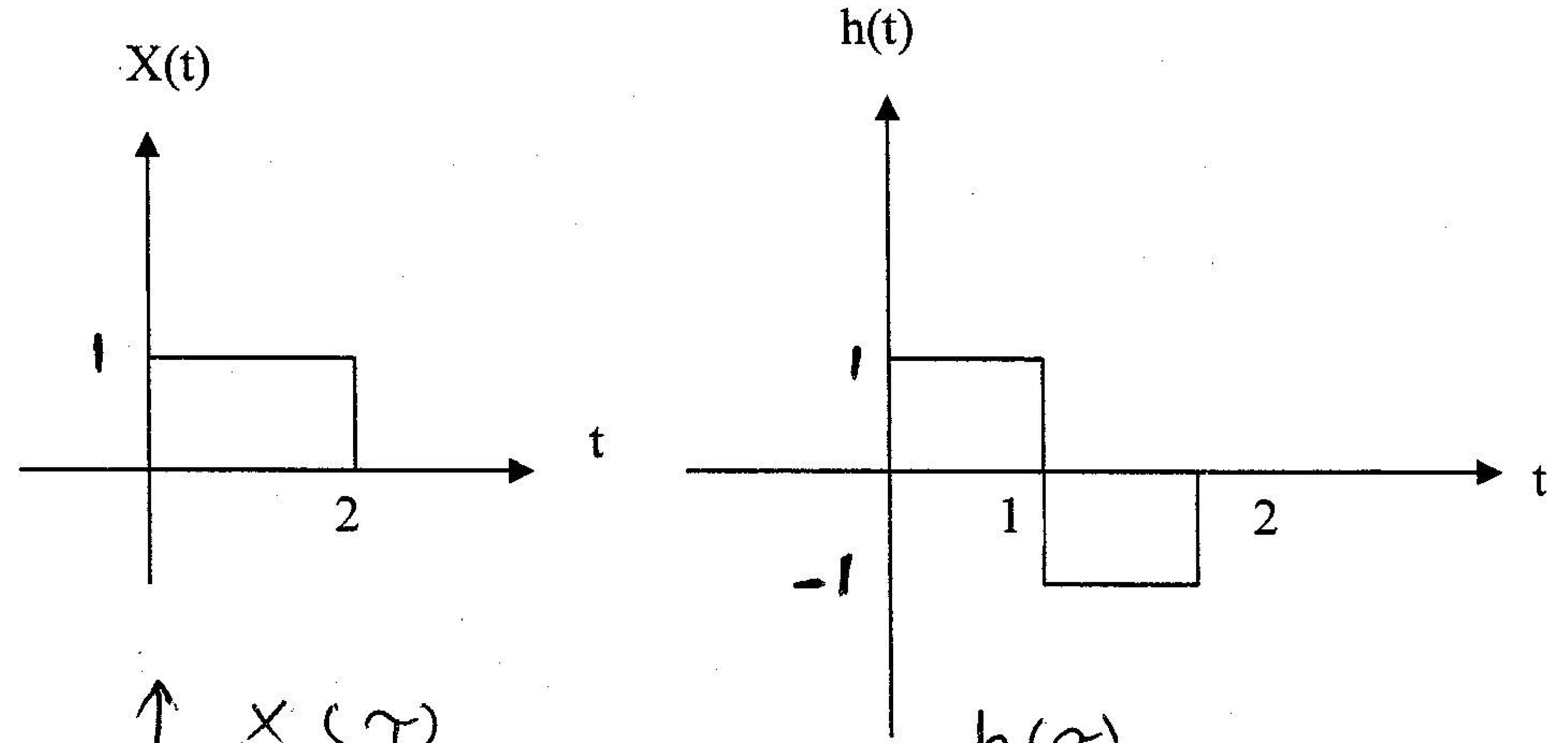
Palestine Technical University - Kadoorie

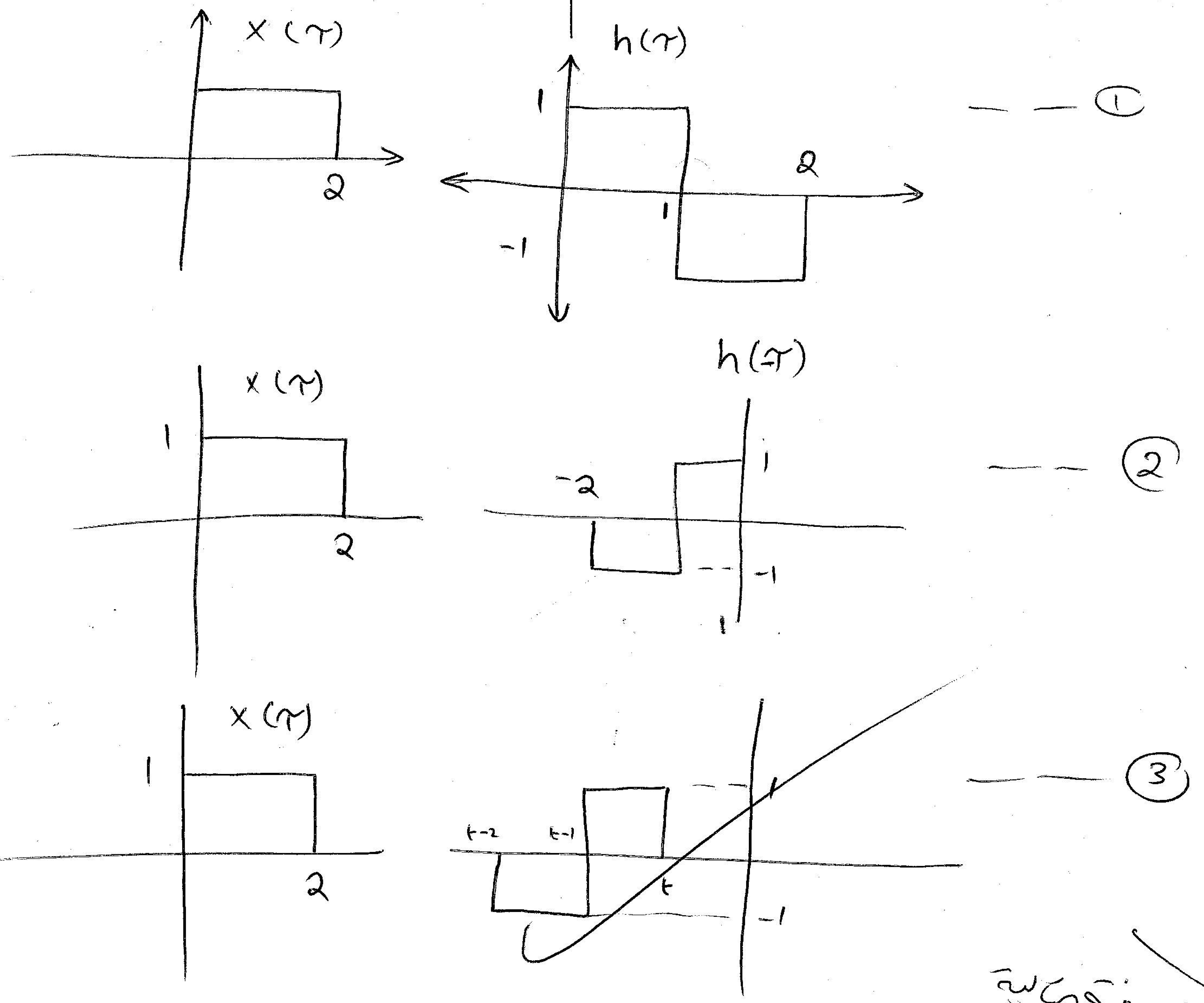
first……Exam
first……Semester 2012/2013

Instructor's Name :
Student's Name: …………………………
Student's Number: ……………………..
Section's Number: ……………………….
Exam's Date :*11/04/2013*
Form :

4/8

Q2)Find and draw the output response y(t) if the input x(t) and the impulse response are as given below (8 marks)

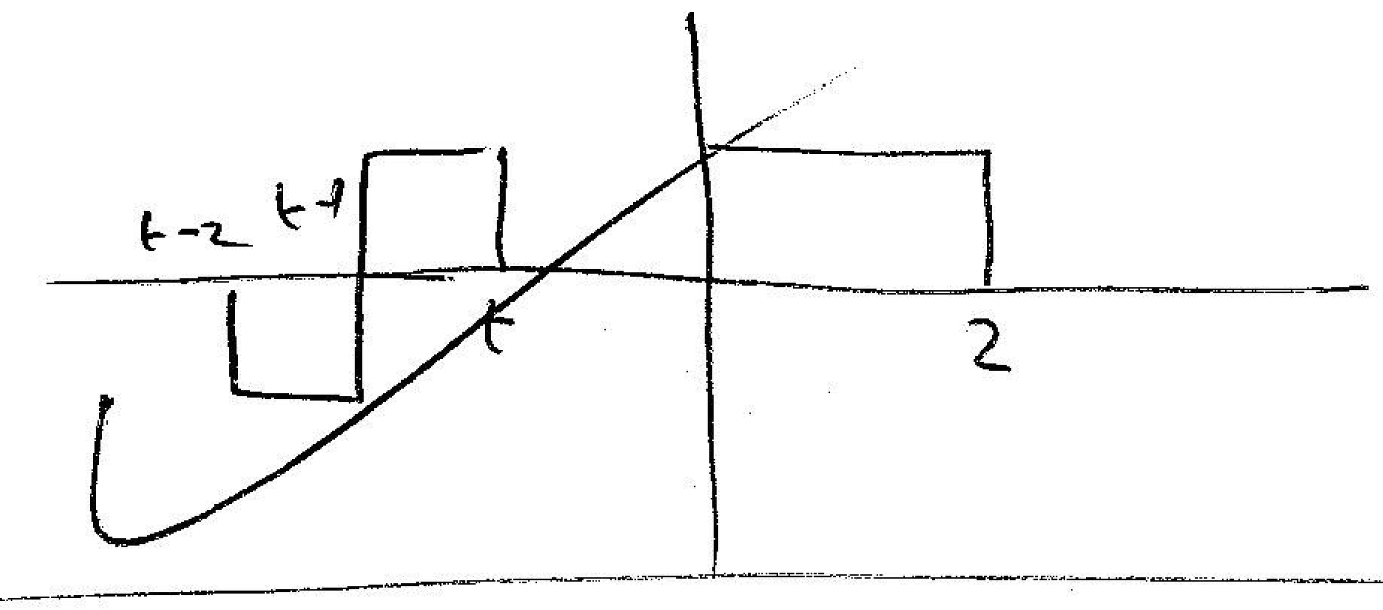




صفحة تالية

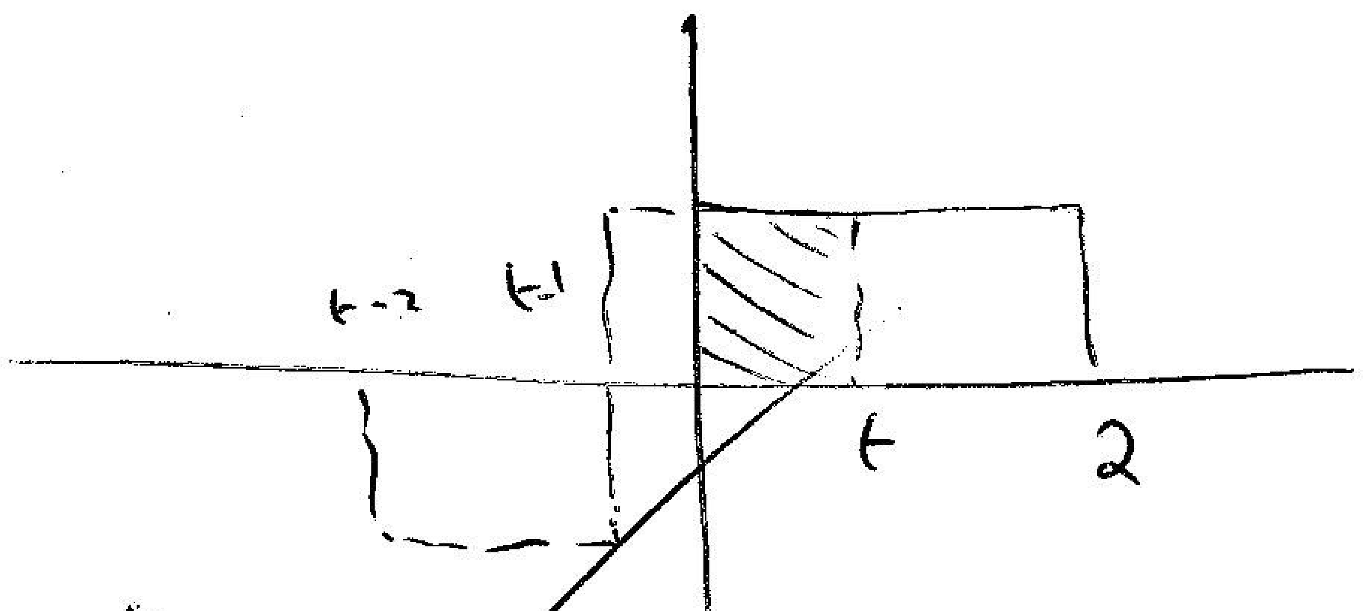
Page 3

① for t large and negative (No overlap!!)



$y(t) = 0$

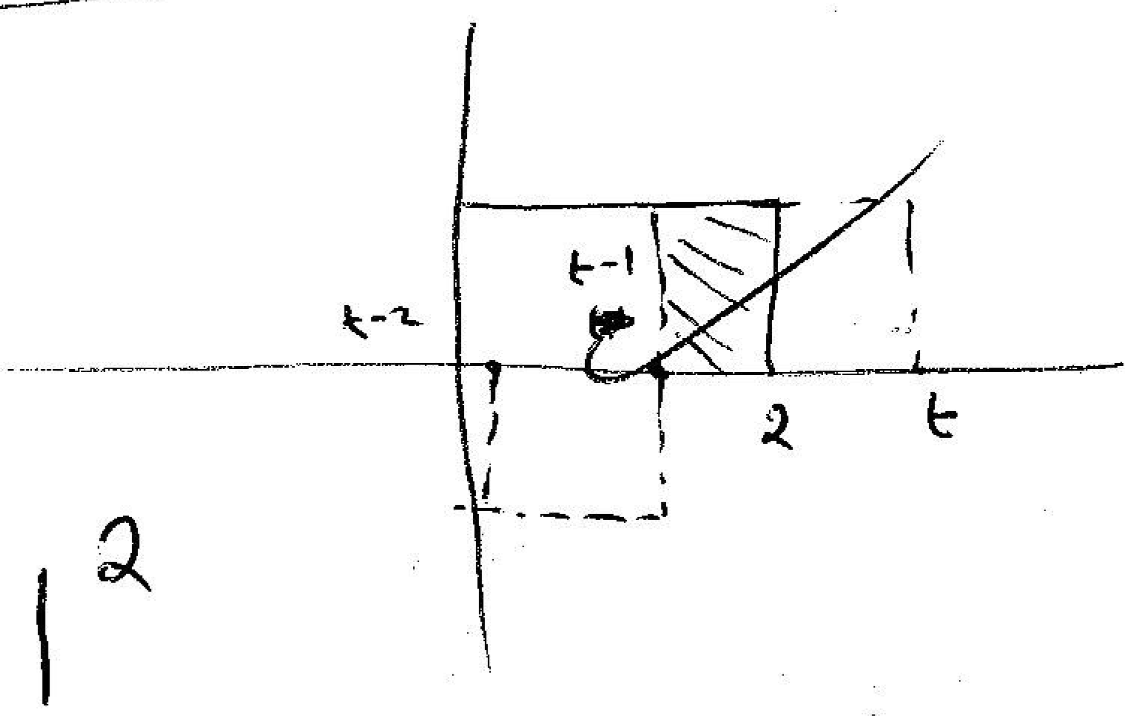
② $0 < t < 1$



$y(t) = \int_0^t 1.1 \, d\tau = \tau \Big|_0^t = \boxed{t}$

0,3 $\quad -t+3$
1,2
2,1

③ $1 < t < 2$



$y(t) = \int_{t-1}^{2} 1 \cdot 1 \, d\tau = \tau \Big|_{t-1}^{2}$

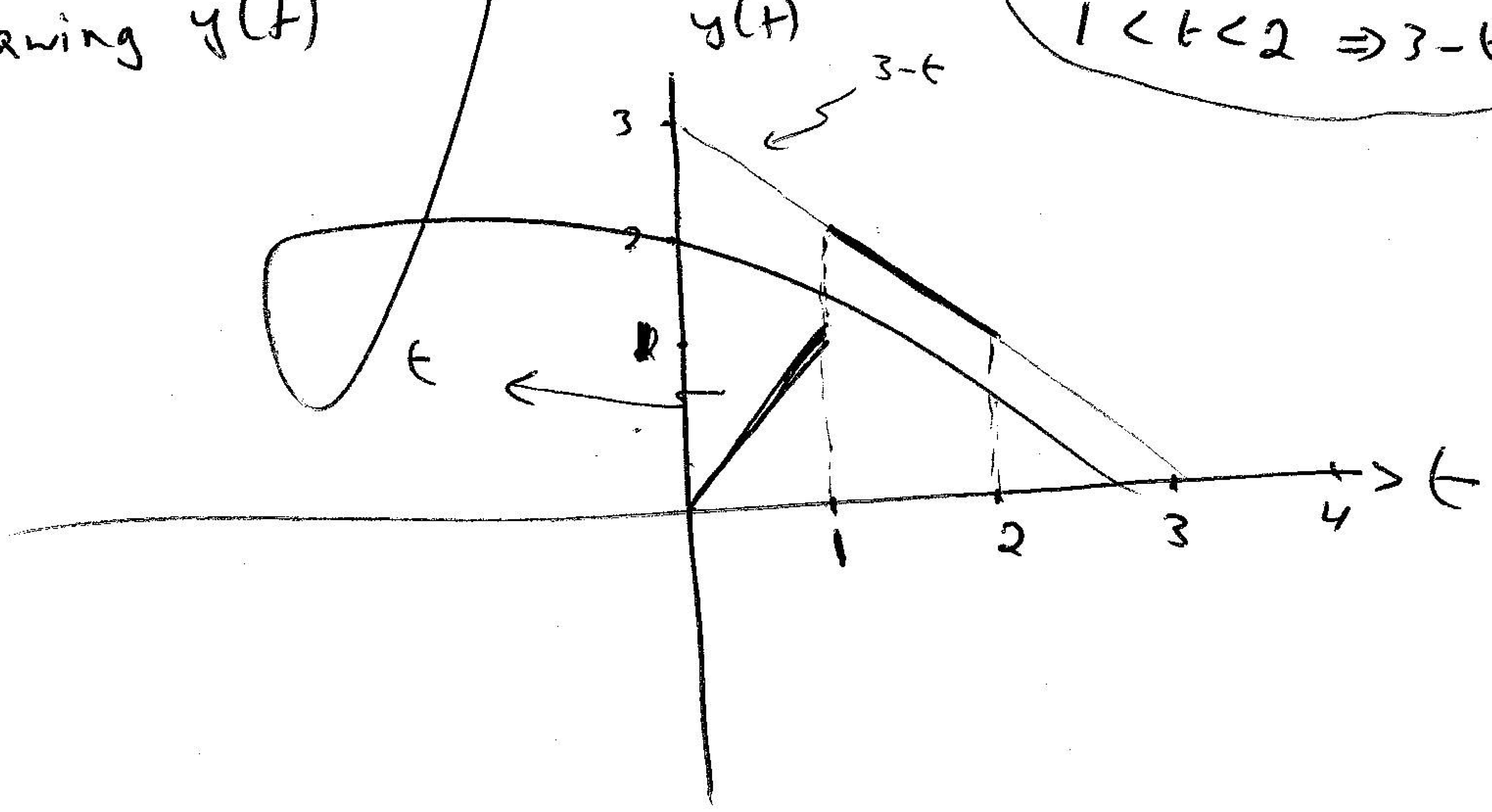
$= 2 - (t-1) = 2 - t + 1 = \boxed{3-t}$

for $t > 2$ (No overlap!!)

$y(t) = 0$

⊛ Now drawing $y(t)$

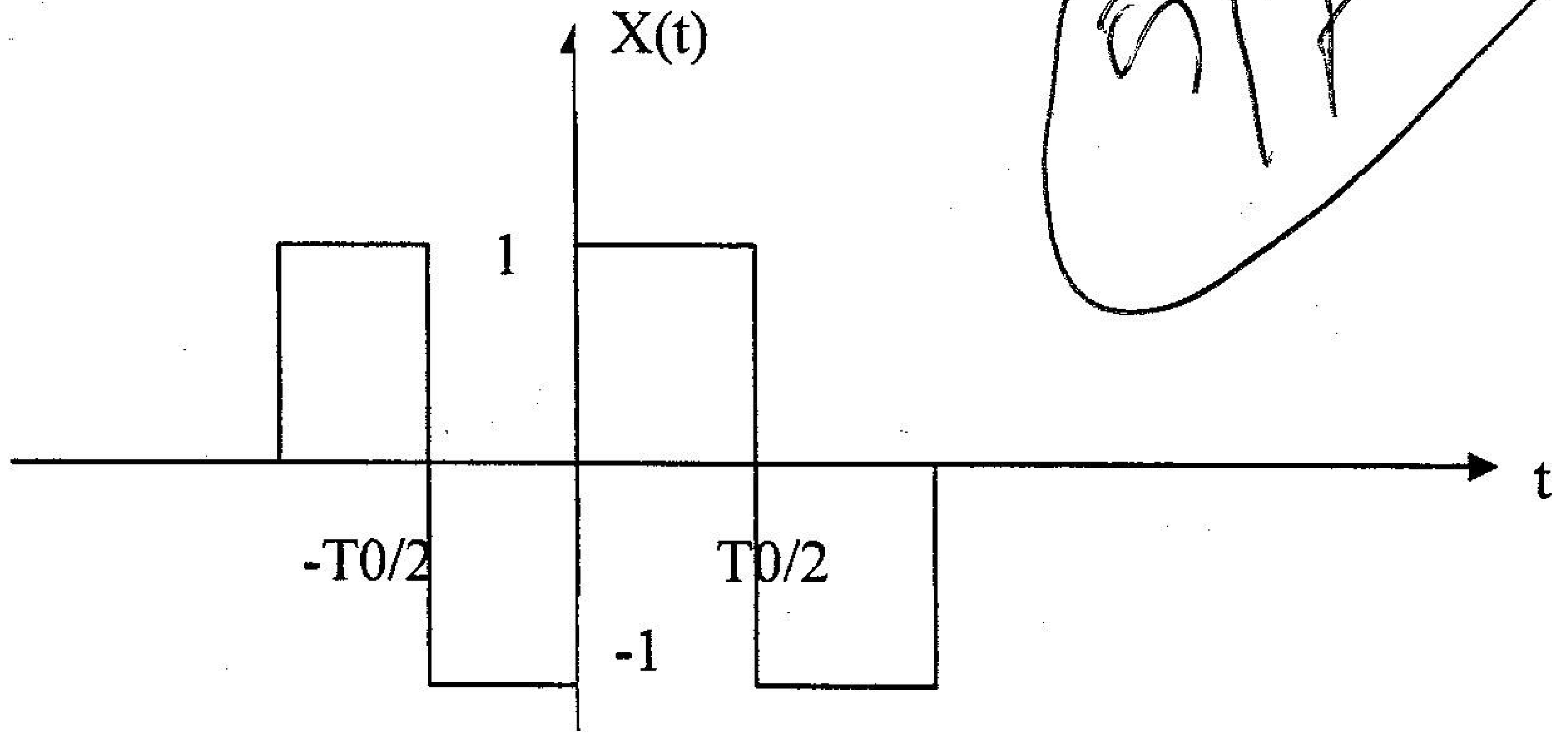
$0 < t < 1 \Rightarrow t$
$1 < t < 2 \Rightarrow 3-t$



***Course's Name :**analog communication*	**Palestine Technical University - Kadoorie**	***Instructor's Name :***
Course's Number :		***Student's Name:** ....*
***Exam's Period** 1hours*		***Student's Number:** ....*
***Questions' Number** :4*		***Section's Number:** ....*
***Total Mark** :30*		***Exam's Date** :11/04/2013*
***Pages' Number**4:*	*first......Exam*	***Form :***
	first.......Semester 2012/2013	

Q3)Find the complex exponential Fourier series representation of the following signal and draw the amplitude and phase spectrum of the signal (7 marks)

5/7



$$C_n = \frac{1}{T_0}\int g_p(t)\, e^{-j2\pi f t}\, dt$$

$$\therefore C_n = \frac{1}{T_0}\int_{-T_0/2}^{0} -1\, e^{\frac{-j2\pi n t}{T_0}}\, dt + \frac{1}{T_0}\int_{0}^{T_0/2} 1\cdot e^{\frac{-j2\pi n t}{T_0}}\, dt$$

$$= \frac{+1}{T_0}\left(\frac{T_0}{+j2\pi n}\right) e^{\frac{-j2\pi n t}{T_0}}\Bigg|_{-\frac{T_0}{2}}^{0} + \frac{1}{T_0}\left(\frac{T_0}{-j2\pi n}\right) e^{\frac{-j2\pi n t}{T_0}}\Bigg|_{0}^{T_0/2}$$

$$= \frac{1}{j2\pi n}\, e^{\frac{-j2\pi n t}{T_0}}\Bigg|_{-\frac{T_0}{2}}^{0} + \frac{-1}{j2\pi n}\, e^{\frac{-j2\pi n t}{T_0}}\Bigg|_{0}^{T_0/2}$$

$$= \frac{1}{j2\pi n}\left(1 - e^{\frac{+j2\pi n}{T_0}\left(+\frac{T_0}{2}\right)}\right) + \frac{-1}{j2\pi n}\left(e^{\frac{-j2\pi n}{T_0}\left(\frac{T_0}{2}\right)} - 1\right)$$

$$= \frac{1}{j2\pi n}\left(1 - e^{j\pi n}\right) + \frac{-1}{j2\pi n}\left(e^{-j\pi n} - 1\right)$$

$$= \frac{-1}{j2\pi n}\left(e^{j\pi n} - 1\right) + \frac{-1}{j2\pi n}\left(e^{-j\pi n} - 1\right)$$

$$= \frac{-1}{j2\pi n}\left(e^{j\pi n} - 1 + e^{-j\pi n} - 1\right) = \frac{-1}{j2\pi n}\left(e^{j\pi n} - e^{-j\pi n} - 2\right)$$

$$= \frac{-1}{j2\pi n}\left(e^{j\pi n} - e^{-j\pi n}\right) + \frac{-1}{j2\pi n}(-2)$$

$$= \frac{-1}{\pi n}(\sin \pi n) + \frac{2}{j2\pi n} = \boxed{\text{Sinc}(n) + \frac{1}{j\pi n}}$$

page 5

Course's Name :*analog communication*	**Palestine Technical University - Kadoorie**	***Instructor's Name :***
Course's Number :		***Student's Name:*** ....
Exam's Period *1hours*		***Student's Number:*** ....
Questions' Number :4		***Section's Number:*** ....
Total Mark :30		***Exam's Date :11/04/2013***
Pages' Number4:	*first......Exam*	***Form :***
	first......Semester 2012/2013	

$2\frac{1}{2}$

Q4)The spectrum of the signal x(t) is given in the figure below (7 marks)

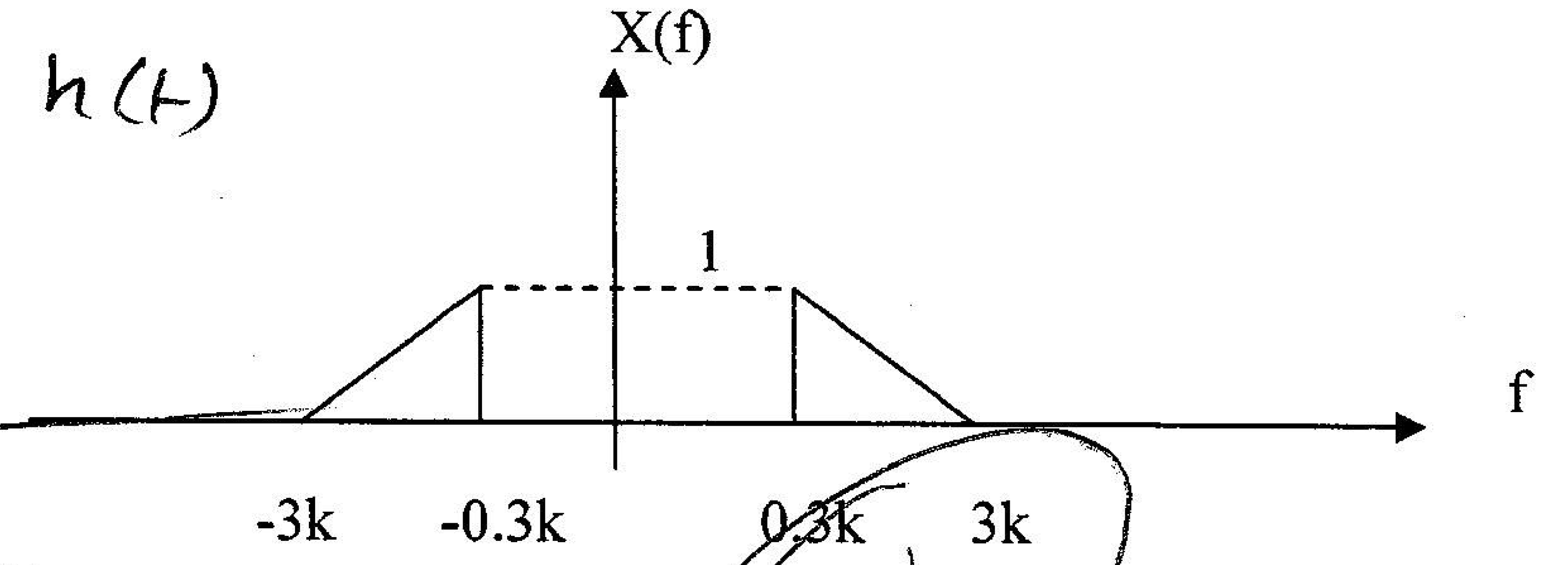
a)Find and draw the spectrum of the signal y(t)=x(t)[cos(2π*3000t)]

b)Find and draw the spectrum of the signal y(t)=2x(t-2)

t_0

$\cos(2\pi \times 3000t) = h(t)$

$\cos(2\pi f t) = h(t)$



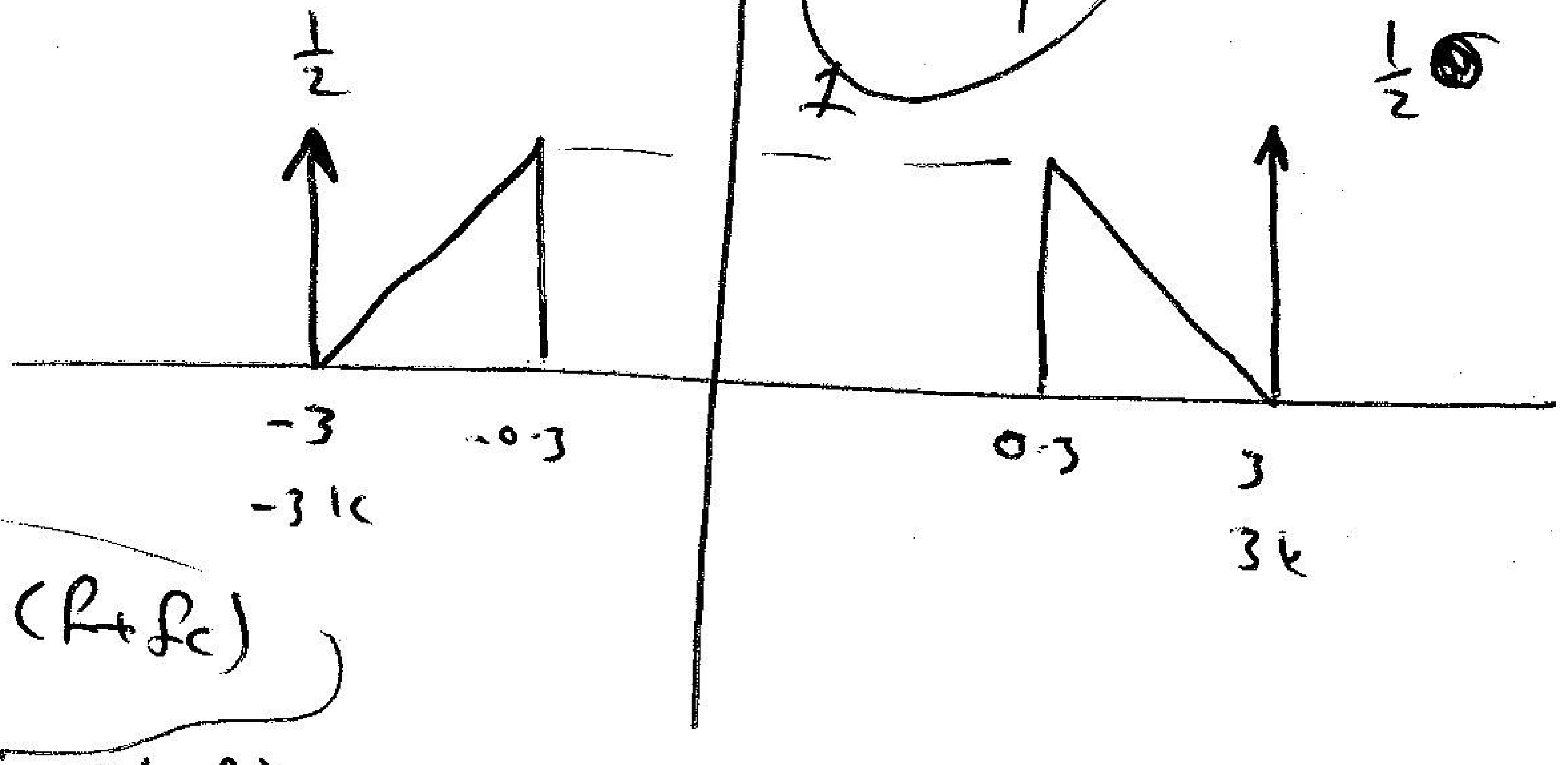
$F(\cos 2\pi f t)$

$= \frac{1}{2}\delta(f-f_c) + \frac{1}{2}\delta(f+f_c)$

1

(a)

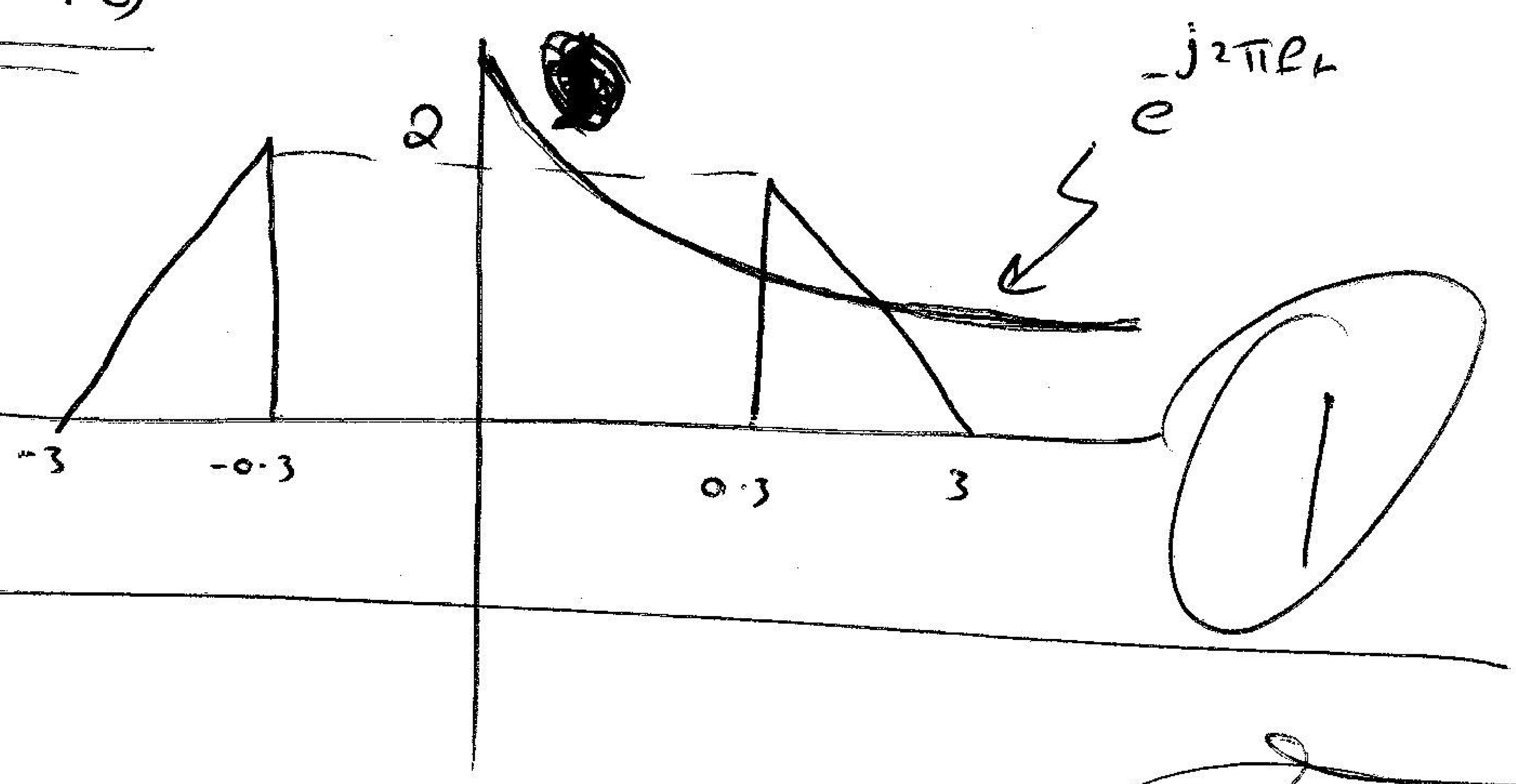
$y(f) = x(f)\, h(f)$



$h(f) = \frac{1}{2}\delta(f-f_c) + \frac{1}{2}\delta(f+f_c)$

$= \frac{1}{2}\delta(f) + \frac{1}{2}\delta(-f)$

(b) $y(t) = 2x(t-t_0)$



1

multiply by 2 and multiply by exponential $e^{-j2\pi f t}$

shift in time domain = multiplying in exponential in frequency domain

Property	Mathematical Description
1. Linearity	$ag_1(t)+bg_2(t)\rightleftharpoons aG_1(f)+bG_2(f)$ where a and b are constants
2. Time scaling	$g(at)\rightleftharpoons \frac{1}{\lvert a\rvert} G\left(\frac{f}{a}\right)$ where a is a constant
3. Duality	If $g(t)\rightleftharpoons G(f)$, then $G(t)\rightleftharpoons g(-f)$
4. Time shifting	$g(t-t_0)\rightleftharpoons G(f)\exp(-j2\pi f t_0)$
5. Frequency shifting	$\exp(j2\pi f_c t)g(t)\rightleftharpoons G(f-f_c)$
6. Area under $g(t)$	$\int_{-\infty}^{\infty} g(t)dt = G(0)$
7. Area under $G(f)$	$g(0)=\int_{-\infty}^{\infty} G(f)df$
8. Differentiation in the time domain	$\frac{d}{dt} g(t)\rightleftharpoons j2\pi f G(f)$
9. Integration in the time domain	$\int_{-\infty}^{t} g(\tau)d\tau \rightleftharpoons \frac{1}{j2\pi f} G(f)+\frac{G(0)}{2}\delta(f$
10. Conjugate functions	If $g(t)\rightleftharpoons G(f)$, then $g^*(t)\rightleftharpoons G^*(-f)$
11. Multiplication in the time domain	$g_1(t)g_2(t)\rightleftharpoons \int_{-\infty}^{\infty} G_1(\lambda)G_2(f-\lambda)d\lambda$
12. Convolution in the time domain	$\int_{-\infty}^{\infty} g_1(\tau)g_2(t-\tau)d\tau \rightleftharpoons G_1(f)G_2(f)$.

Table A6.4 Trigonometric Identities

$\exp(\pm j\theta)=\cos\theta \pm j\sin\theta$

$\cos\theta=\frac{1}{2}[\exp(j\theta)+\exp(-j\theta)]$

$\sin\theta=\frac{1}{2j}[\exp(j\theta)-\exp(-j\theta)]$

$\sin^2\theta+\cos^2\theta=1$

$\cos^2\theta-\sin^2\theta=\cos(2\theta)$

$\cos^2\theta=\frac{1}{2}[1+\cos(2\theta)]$

$\sin^2\theta=\frac{1}{2}[1-\cos(2\theta)]$

$2\sin\theta\cos\theta=\sin(2\theta)$

$\sin(\alpha\pm\beta)=\sin\alpha\cos\beta\pm\cos\alpha\sin\beta$

$\cos(\alpha\pm\beta)=\cos\alpha\cos\beta\mp\sin\alpha\sin\beta$

$\tan(\alpha\pm\beta)=\frac{\tan\alpha\pm\tan\beta}{1\mp\tan\alpha\tan\beta}$

$\sin\alpha\sin\beta=\frac{1}{2}[\cos(\alpha-\beta)-\cos(\alpha+\beta)]$

$\cos\alpha\cos\beta=\frac{1}{2}[\cos(\alpha-\beta)+\cos(\alpha+\beta)]$

$\sin\alpha\cos\beta=\frac{1}{2}[\sin(\alpha-\beta)+\sin(\alpha+\beta)]$

The Fourier representation of $sq(\theta(t))$

$$sq(\theta(t)) = \frac{4}{\pi}\sum_{k=1}^{\infty}\frac{(-1)^{k-1}}{2k-1}\cos\left[2\pi(2k-1)f_c t+(2k-1)\phi(t)\right].$$

For a square periodic function with period T_c The Fourier representation of $P(t)$ is

$$P(t)=\sum_{n=1}^{\infty} 2\operatorname{sinc}(n/2)\cos 2\pi n f_c t = \frac{4}{\pi}\cos 2\pi f_c t - \frac{4}{3\pi}\cos 6\pi f_c t + \cdots$$